Social Network Analysis of a Blended Learning experience in higher education

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ABSTRACT

This paper is about a blended learning experience which combines face to face classes with virtual sessions in higher education. As far as we know, interactive relationships in e-learning can influence the process and quality of knowledge building. The aim of this study is to investigate empirically the relationships between network structures and social knowledge building in an asynchronous writing environment through discussion forums into a learning management system (LMS). Taking into account all the messages produced and shared in this experience by both teachers and students, we are going to organize all of them and analyze how they interact in the learning process.

KEYWORDS: Blended Learning, Social Network Analysis, Higher Education.

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Introduction

Current educational practices are adopting the use of technologies as an essential support for learning. Since last century, we are witnessing how the information and communication technologies are increasingly affecting the learning process and providing students and teachers with learning experiences, which they could not otherwise experience (Kamil, 1999).

There are many resources that reinforce teaching. One of them is Moodle which has lots of possibilities and a great potential. It is a tool that complements on-site teaching at all levels of the education system so that its benefits for learning need to be studied further because students see the platform in a very positive light (Mena, Olmo, Torrecillas & Iglesias, 2013).

Moreover, Herrero (2014) found that Moodle is the most used and distinguished resource for students. They believe it helps in acquiring them skills without requiring students to be present in the classroom. For these reasons, Moodle is a resource of interest in teaching.

This learning management system allows us to build and manage courses through an online learning community, in which, in addition to sharing resources, we have multiple asynchronous communication forums for collaborative work.

The network structures can be analyzed using a social network analysis of the response relations among participants during online discussions. On this way, there are two main active agents acting during the learning processes, but it is the teacher who has to get a facilitator roll being wailing to mix different methods (virtual and face-to-face lessons, for example). According to previous researches headed by Cabero, Llorente & Puentes (2010), an active attitude of the teacher is one of the most important thing, and totally necessary, to implement successfully mixed learning strategies (Blended Learning), also supported by the suitable infrastructure provided by the institution, trying to make the teaching easier. Moreover, active online participation is a key factor in the success of student learning (Hiltz & Turoff, 2000).

This research analyzes the interactions that occur in a blended learning experience in higher education. Thus, we analyzed how 6 groups developed collaborative learning social networks when participants worked together on 4 activities.

1. Theoretical framework

New information technologies have opened up a huge range of possibilities in the education field, which have provided students and teachers several instruments and tools facilitating the development of new working methods, and therefore, new skills. Thus, the ability to combine face-to-face teaching with the virtual one has been a substantial contribution in order to design and conduct different training sessions by teachers.

We must consider that "Information and Communication Technologies (ICT) have an important influence on the evolution of every company on the planet and affect significantly all (economic, social or cultural) dimensions of functioning

of societies. With ICT, everything changes: the way of teaching, living, learning, working and even living" (Karsenti y Lira, 2011: 112-121).

It is important to remember the list of elements for Blended Learning proposed by Clark (2003).

Offline Component		On-line Component	
Physical place for learning	- Learning in the workplace - Visits to physical places	**On-line learning contents**	- Basic resources for learning - General interactive contents - Performances and simulations
On-line tutor	- Tutoring - Following up	**On-line tutor**	- On-line tutoring - On-line following up
Class work	- Readings - Seminaries - Role-plays - Conferences	**On-line collaborative learning**	- E-mail - Forums - Work via chat - Videoconferences
Printed media	- Books - Journals - Newspapers	**On-line learning management**	- Guidelines for searches - Documents and files recovery
Electronic media	- Audio CDs - CD-ROMs - DVDs	**Internet**	- Websites - Blogs
Mass media	- TV - Radio - Interactive television	**Mobile devices**	- Notebooks - PDAs - Smartphones

Table 1. List of elements for Blended Learning (Clark, 2003)

Several years after the birth of learning management systems supported by new technologies, the implementation of LMS in higher education has caused the need for studying interactions among participants, constituting a new dimension of analysis by itself. One of the factors indicative of the success of Blended Learning systems is the quantity and quality of the interactions that are produced in synchronous and asynchronous communication forums, in which questions are posted and solved, and information is shared in various formats (photo, video, audio, podcast), both on educational issues (at a given time) as on social and daily life themes (schedules, news, release notes).

It has no sense to ignore the socializing effect of different educational proposals supported by Blended Learning systems in general, and more specifically, communication forums, spaces for free exchange of information between students and teachers. As new technology products have appeared, teachers have been incorporating them into their working methods on a completely voluntary way, without any imposition by educational institutions. "There is not a factor of imposition or pressure to use them for heads or seniors, it must be understood that in the context of public universities there is sufficient freedom for teachers to incorporate or not certain teaching innovations. It seems clear that teachers are more sensitive to adopt them sooner or later, by the perception of the uni-

versity environment elements that act as motivators (responsible pressure for academic administration or students themselves) or simple imitation effects (influence from peers)" (Martín, García & Muñoz, 2014: 235-236). Based on this though, it is clear that within the possibilities offered by a given system, the use of mixed learning systems is increasingly given the large benefits derived from it, which have a direct impact on the teaching/learning processes.

Social Network Analysis (SNA) provides a new paradigm and methods for assessing knowledge building in online learning environments. Thus, it is been used as a tool to understand online classes. It analyses the interactive relationships among participants by using algebra matrix and graph theory tools to describe the patterns of interactions and characteristics of networks with network measures. The factors taken into account in this study are the following:

- *Group size:* it is one of the main structural determinants of the level of possible participation in a network.
- *Density:* it shows the value of high or low network connectivity. It is a measure expressed as a percentage between the number of existing relationships with potential. It is calculated by dividing the number of possible relationships multiplied by 100
- *Centrality:* the number of actors to which an actor is directly linked. It is divided into input degree (that is the sum of the interactions referred to an actor on the other) and output degree (sum of relations that actors have with the rest).
- *Centralization:* is a special condition in which one participant acts as the center being highly connected to the network.

2. Aim of the study

The aim of this study is to discover the structural characteristics as a whole in each of the social networks created so we perform a social network analysis (SNA). In a blended learning educational context, we tried to investigate empirically the relationships between network structures and social knowledge building in an asynchronous writing environment through discussion forums into a LMS (Moodle). All questions and responses exposed in these forums during the sessions were collected to show which sort of activities had more and less participation, and the most active members on the top of the groups list.

3. Methodology

Participants

The study participants were 21 students aged between 21-25 years from different degrees of the University of Huelva (Spain). Specifically, students who participated in this experience were studying History, Teaching, Humanities, Business Management, Law, Social Work and Psychology.

Procedure

All students participated in a blended learning course. They were offered a tech-

nology orientation session the first day of class. After that, they were randomly assigned to small groups of three-four components so they were organized into 6 online working groups. This research main´s tool is the LMS (Moodle) where we carried out the online part of the course. They participated in a four weeks online course. Finally, one last class was held face to face. In this study, we used methods of Social Network Analysis (SNA) to analyze four activities of the course developed in Moodle. There were many available tools: shared resources, chats, private and public forums…The four activities had instructions and one week of time to be solved.

In this study, we want to show how students worked through descriptive data. We are also interested in analyzing factors as *size, density*, *centralization* and *cohesion*, of the groups.

Instruments

We used UCINET 6 for Windows which is a software package for the analysis of social network data. It was developed by Borgatti, Freeman and Everett (2002). It comes with the NetDraw network visualization tool. On the one hand, we used UCINET to analyze the interactive relationships among participants by using algebra matrix (Appendix 1) and on the other hand, we used NETDRAW graph theory tools to describe the patterns of interactions and characteristics of networks with network measures.

4. Results

In Appendix 1 we present the number of interactions produced in every discussion group. Each group member could direct his/her participations to the discussion forum, to other member individually or to the tutor, as we can see in table 2.

GROUP	STUDENT-FORUM	STUDENT -STUDENT	STUDENT-TUTOR	TUTOR-FORUM	TUTOR-STUDENT	TOTAL
A	54	33	0	7	0	94
B	37	40	4	1	2	84
C	20	6	0	3	1	30
D	23	9	0	2	0	34
E	12	10	0	3	1	26
F	35	5	1	3	0	44
TOTAL	**181**	**101**	**5**	**19**	**4**	**310**
%	**58,4%**	**32,6%**	**1,6%**	**6,1%**	**1,3%**	**100%**

Table 2: Descriptive results

As we can see, all participants, tutor included, sent 310 messages in total between them through Moodle Forum tool. Most of the messages (92,6%) were sent by students, in order to complete every task requested by the tutor whose participation was the 7,4% of messages; it shows that they have been supporting each other during the course. Although groups A and B have the highest number of interactions (94 and 84 respectively), the other groups C, D, E and F got enough

ones. It is important to notice the teaching presence in this experience: the more messages produced by the tutor, the more number of interactions between students.

Social Network Analysis was used to discover the structural characteristics as a whole in each of the social networks created. For this analysis we used NETDRAW that revealed the interactive relationships produced in the different groups as we can see in figure 1.

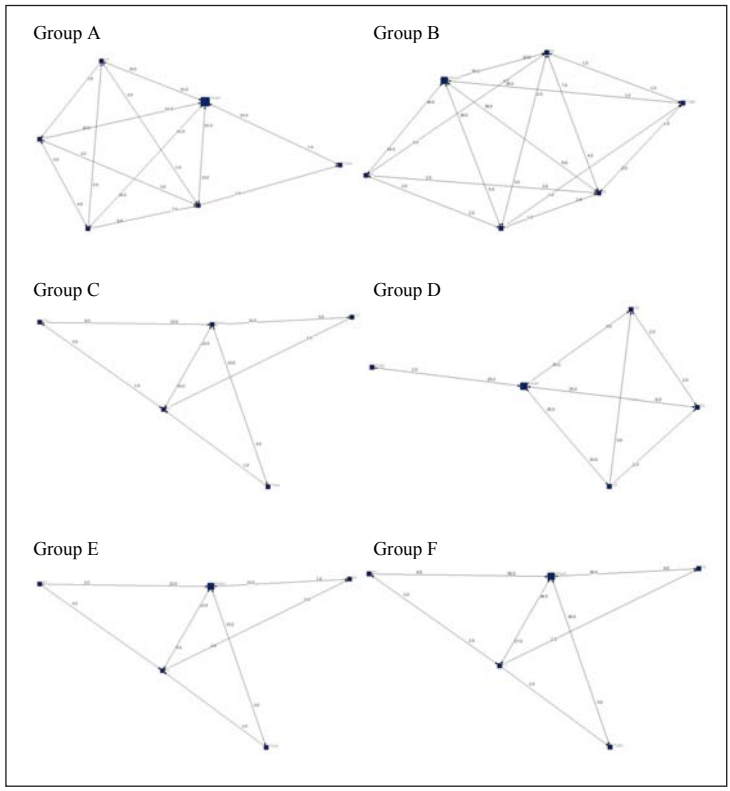

Figure 1: Patterns of interactions

According to the variables studied, groups A and B have higher indices of cohesion. As we can see in Figure 1, they have more links among members presenting a stable polygon. The more closed networks are those with higher levels of cohesion and density.

Group	Size	Density / average matrix value	Network Centralization (Indegree)	Network Centralization (Outdegree)	Cohesion
A	4	13.3333	1.705%	93.770%	0.850
B	4	9.0000	3.158%	91.579%	0.950
C	3	6.0500	5.163%	92.120%	0.800
D	3	6.7000	4.000%	91.500%	0.800
E	3	5.8500	11.685%	93.207%	0.800
F	3	9.8000	0.658%	92.763%	0.800

Table 3: Centralization and density of groups

There are many differences among groups. In this sense, groups A, B and F have higher levels of density and centralization. Larger values in cohesion indicate greater cohesiveness (Cohesion range 0 to 1). On the other hand, related to participants' centralization that is a special condition in which one participant acts as the center being highly connected to the network, we can see several students with this role in groups A and B, meanwhile there is only one central actor in the rest of the groups.

Conclusion

New mentalities established in hyper-connected populations are changing the way in which we access to information and also the configuration of the learning strategies on education field. According to the results shown before, we found that most messages are produced by students showing that collaborative learning could be considered a powerful instrument for socializing among student community giving the students an active role in their learning process. Group size was relevant because groups A and B had four students and the rest of the groups only three. We believe this factor affected to the other variables studied as we found higher levels of density, centralization and cohesion in group A and B. In general, centralization indices (out-degree) are very high indicating that most of the messages that come to the forum refer to all members of the group (Example: "we have to discuss together the information given"). In this sense, high levels reaching centralization must be understood in the context of social networks, in which messages sent to all members of the group are the most frequent. On the other hand, in-degree centralization indices are low, indicating that team members have received a similar number of messages. We found similar results in the research conducted by Tirado, Hernando & Aguaded (2012) where they found an inverse relationship between the in-degree centralization index and the out-degree centralization index. Just in this point, we extract the essence of blended learning formative sessions, having to distinguish, firstly, all tools and instruments coming from a LMS (Moodle in our case), and secondly, an active attitude of the participants, both of them are able to create a more permeable and suitable environment where students learn more easily.

In this study, we just present some evidence on the need to analyze virtual learning. Results show the potential of analyzing networks for a better under-

standing of online knowledge construction. According to Schalk & Marcelo (2010) we conclude that there exists the need to analyzing that goes beyond the written discourse in asynchronous communication to establish relations with both cognitive and social learning of students.

As far as we know, online learning interactions must be analyzed in order to understand the messages produced in synchronous and asynchronous forums available in each virtual environment. There is no doubt that Moodle is a tool that complements classroom instruction promoting interactive learning. Therefore, it facilitates the construction of knowledge through interactive learning (Mena et al., 2013).

Finally, students' opinions about their satisfaction level by using both virtual and face-to-face learning strategies go on the same line. The experience has been valued as excellent and recommended by all the students. One of the most generalized comments was the desire to repeat learning activities like this, combining face to face lessons with online activities. It has welcomed the last classroom session in which has been conducted a final activity and have discussed some aspects of the organization and the course format. Based on this successful educational experience we encourage all teachers to use, promote and implement this kind of Blended Learning possibilities which are offered by mixing face to face classes and new technologies.

The involvement of all participants has been high and quality. They have developed interesting proposals and resources as a result of social interaction produced through this blended learning experience. This issue could be directly related to the extra motivation when new technologies are used by teachers in higher education, encouraging participation among students while they are socializing. It seems that the situation is changing, contrasting with the results found by Dahawy and Kamil (2009) in their research where students preferred passive like techniques as they expected teachers and instructors to provide all the learning points in class as well as delivering all required discussions.

We consider that analyzing the interactions that occur in the virtual environment has special meaning today because of the importance of being able to improve communication in these contexts. The core of the matter consists on giving students the tools necessary to create themselves an efficient working network for sharing and producing knowledge using technologies that they are used to engage in their daily routines.

This study is being extended in order to improve the analysis of networks in knowledge building through collaborative work in discussion forums.

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Appendix 1

In this appendix we present the number of interactions produced in every discussion group. Each group member directs his participations to the discussion forum or to other member individually.

Group A	A1	A2	A3	A4	Tutor	Forum
A1	X	6	4	2	0	16
A2	7	X	3	1	1	13
A3	3	2	X	0	0	15
A4	0	2	3	X	0	10
Tutor	0	0	0	0	X	7
Forum	61	61	61	61	61	X

Group B	B1	B2	B3	B4	Tutor	Forum
B1	X	4	3	2	2	8
B2	7	X	4	2	1	10
B3	2	4	X	2	0	14
B4	1	3	2	X	1	5
Tutor	1	1	0	0	X	1
Forum	38	38	38	38	38	X

Group C	C1	C2	C3	Tutor	Forum
C1	X	0	1	0	10
C2	1	X	0	0	4
C3	3	0	X	0	6
Tutor	1	0	0	X	3
Forum	23	23	23	23	X

Group D	D1	D2	D3	Tutor	Forum
D1	X	2	0	0	6
D2	2	X	0	0	7
D3	2	3	X	0	10
Tutor	0	0	0	X	2
Forum	25	25	25	25	X

Group E	E1	E2	E3	Tutor	Forum
E1	X	1	0	0	9
E2	5	X	0	0	1
E3	3	0	X	0	2
Tutor	1	0	0	X	3
Forum	23	23	23	23	X

Group F	F1	F2	F3	Tutor	Forum
F1	X	2	2	1	17
F2	0	X	0	0	9
F3	1	0	X	0	9
Tutor	0	0	0	X	3
Forum	38	38	38	38	X